PART 8

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PART 8

GENERAL MECHANICAL REQUIREMENTS

8.1 Bio-Gas Cleaning Equipment and Peripheral Equipment

(a) Generated 100% of the raw Bio-Gas shall cleaned by the Desulfurization equipment (H_2S Scrubbing) to meet the requirement of gas component for Gas Hot Water Boiler and gas engine so that maintenance cost shall be reduced as well as enhancing life of the energy recovery systems.

(b) The Scrubber shall be chemical type, it can be single/ double stage based on the capacity. Maximum H_2S content at inlet condition shall be 5000 to 10000 ppm. Operation shall be automatic through PLC/SCADA with manual override system. And inlet pressure shall be of 200 to 300 mm wc. Outlet Biogas shall have maximum 100 ppm H_2S content.

(c) The material of construction of Tank, Tower, Drum, Venturi, Reaction column, Recirculation pumping/Drain line, Gas line and Water line shall be SS 316.

(d) Recirculation Pump shall be of centrifugal type with CF8M material of construction.

(e) Caustic Dosing Pump shall be of Plunger type, Plunger shall be SS316L, Liquid end and Through Bush shall be of SS316 and Gland Packing PTFE.

(f) Biogas Scrubber shall have dehumidifier unit which shall consist of Chiller, SS316 Shell tube type Heat Exchanger, condensing unit, PH Analyzer unit and control Panel.

Cleaned Biogas shall be sent to Biogas Engine or flare with the Gas blower.

The work shall include but not necessarily be limited to the following;

(1) Gas supply line and valves.
(2) Desulfurization equipment.
(3) Flame arrester and trapping.
(4) Pressure relief valves with flame arrestor.
(5) Moisture trap.
(6) Dehumidifier and Dryer unit.
(7) Caustic Dosing unit.
(8) Recirculation Pumps
(9) Sedimentation trap
(10) Biogas filter

(11) Biogas blower
(12) Drain

(g) To supply all equipment and devices, Contractor shall submit all related technical information such as Design concept and calculation, Gas component analyses and inlet and outlet parameters at the equipment for client approval in advance.

(h) Contactor shall provide all necessary equipment and low cost operation system essential to meet the requirement of Gas Engine.

(i) Desulfurization equipment

Highly concentrated H_2S chemical substance shall be removed to proper level by sodium hydroxide tower or catalytic action or biological method to protect loss in Gas Engine and boiler efficiency and its break-down due to the highly corrosive nature of the gas.

The package shall include complete set of mechanical and electrical equipment's, instrumentation control and automation required for satisfactory and efficient operation of the Plant.

8.2 Peripheral Equipment and devices for Bio-Gas application

(a) Flame Arrest and Trapping assembly

The flame arrestor shall reduce flame power or temperature by metal mesh, and flame trapping is like spring flap door fixed by fuse, which the door shall be instantly closed when its melt by flame to protect fire. Contractor shall provide the assembled the flame arrestor and trap valves on the Biogas line and its equipment to prevent any accident.

The flame arrestor and trap assembled valve shall be of suitable size for biogas applications. It shall be used from primarily sludge digestion to Biogas engine in pipelines, digestors Gas holder to prevent flash back during explosions. This device shall be installed in horizontal or vertical pipeline and hence it should be bi-directional. Other plant items where these units are to be installed are as follows :

- Digestor Tank –at safety unit
- Upstream of Gas Engines

- Upstream of Hot water Boiler
- Upstream of Bio-gas scrubber.

The flame arrestor and trapping assembled valves shall be designed such that they result in minimal pressure loss under normal operating conditions, but ensure maximum safety in the event of an explosion, and the end connection shall be flanged.

It shall be constructed of Stainless steel 304 materials of construction.

(b) Pressure relief valves

The pressure relief valves shall be of suitable size for biogas applications. It shall be used from primarily sludge digesion to Biogas engine in pipelines to keep controling the gas pressure constantly to prevent any unsual presure condition in the pipe line and digestor. This device shall be installed in vertical installed. It shall be constructed of Body SS 304 Epoxy painted, Valve seat ASTM A II b Gr.316,Weight material ASTM A II b Gr.316 and Body Gasket material EPDM.

(c) Gas filters

The Gas filters shall be of suitable size and mesh for biogas applicable. It shall be used upstream of Biogas scrubber, engine and gas mixing blowers in pipelines to supply dirt free biogas to protect engines and gas blowers against loss in engine efficiency and its break-down. These are minimum requirements.This device shall be installed in vertical installation.

It shall be constructed of Stainless steel ASTM A 276 Gr. CF8 materials of construction.

(d) Emergency shut-off valves with bypass line.

The emergency shut-off valves of suitable size shall close automaticaly when it receives signal of abnomal heat temprature and gas presure, which gets activated by CO_2 compressed power cylinder mounted direct on the valve.

Emergency Shut off valve used for Biogas hoder at inlet and outlet in pipline, and at the same moment, a bypass gas pipeline shall provide for maintenace work.The valves shall be installed in vertical installation.It shall be constructed of Stainless steel 304 materials of construction.

(e) Moisture Trap

The moisture traps shall be designed and be suitable size to effectively separate out moisture in the biogas to gas cleaning equipment and biogas engine such that moisture free biogas is made available at the outlet of the trap. It shall be constructed of Stainless steel 304 material of construction. It shall be provided with a suitable drain connection.

(f) Water Trap

The water traps shall be designed and be of suitable size to effectively separate out water in the biogas in pipeline such that water free biogas is made available at the outlet of a trap. It shall be constructed of Stainless steel 304 material of construction. It shall be provided with suitable drain connection.

(g) Sedimentation Traps

The sedimentation traps shall be designed and be of suitable size to effectively separate out all sediments in the biogas pipeline such that sediment free biogas is made available at the outlet of the trap. It shall be constructed of Stainless steel 304 material of construction. It shall be provided with suitable drain connection with safe drip trap arrangement, so as to avoid unsafe leak of gas.

8.3 Rotary Sliding Vane Biogas Blower

General

Rotary Sliding vane Compressor, prime mover and auxiliary equipment shall be designed for the required duty at the specified operating conditions, and for rapid and easy maintenance.

The Sliding rotary vane compressors consist of cylindrical rotor turning eccentrically in a cylindrical stator of a larger diameter, the result is a free half-moon shaped space. Stratified plastic blades slide freely into the rotor slots. These blades, when the rotor turns, are pressed against the internal face of the stator because of the centrifugal force so forming small cells, the volume of

which passes from a maximum to a minimum during the rotation. The suction takes place through ports in the stator and in the area of the increasing volumes, the discharge takes place through ports in the stator and in the area of the decreasing volumes at a given level depending on the foreseen discharge pressure.

The noise level shall not exceed 85 dBA at 1.86 meter from the Blower. Blowers shall not run above 1000 rpm.

Design Requirement

Blower shall be provided for necessary capacity and rating as required and shall be of positive rotary sliding vane, water cooled, single stage oil free gas compressors. The cylinder shall be cast such that gas and water passage shall be separated by metallic wall and shall not have any gasket separating the two.

The gas blowers shall be designed and works tested complete with blower unit, motor, coupling, MS fabricated rigid base plate, water cooling system, gas and water pipe work, forced oil lubrication system, Rubber Anti-vibration Pad, SS 304 Non-return valve, SS 316 Expansion Bellows at inlet and outlet connection of the blower unit, SS 304 Suction filter with SS 316 filtering Element, SS 316 Cyclonic separators, and all regulating and control equipment as required to provide an adequate and efficient compressed high pressure gas supply. Velocity to be considered for gas piping design shall be in the range of up to 4.5 m/s on suction side (gravity air piping) and up to 9 m/s on discharge side. The blowers shall have water seals.

The blowers shall be designed to compress wet and sludge gas comprising methane and CO2 with trace elements including H, N & H2S. The gas shall be assumed to be water saturated.

Gas blower gearbox shall be suitable for continuous running and intermittent starting under maximum load with the resultant high torque and shock loads. The gearbox shall have a service factor of 2 (Minimum).

A pressure relief system shall be included to operate and shut off pressure of blowers. This shall consist of actuated bypass and main gas valves which shall operate to dissipate the high pressure in the delivery main to the low pressure digestion tank.

A temperature sensor shall be installed to give a warning alarm and shut down facility in the event of the pressure relief valve malfunctioning.

(1) Mode of Operation

(a) The blower shall operate on a duty / duty assist basis.

(b) Manual control via start / stop pushbuttons at the control panel with auto switch off in case of temperature bypass or over pressure switch operating.

(c) The blowers are to run on either a timed or continuous control selected by a two position selector switch mounted on the control panel.

(d) When 'continuous' is selected, the blower is to run continuously. Where 'timed' is selected the blower is to run for fixed duration and to be off for fixed duration. The timed cycle shall be controlled by two adjustable timers (0-60 min) provided for each blower.

(e) Blower is to trip and lock out due to the following but the work shall include but not necessarily be limited : (reset shall be manual)

- ✓ Electrical overload
- ✓ Earth fault
- ✓ Motor over-temperature, monitored by thermistors in each phase
- ✓ Over-temperature in the compressor gas delivery pipeline
- ✓ Cooling water over-temperature
- ✓ Rise in discharge pressure
- ✓ Vacuum in suction line

(2) Motors and Control Panels

Motors and Control Panels shall be squirrel cage type conforming to IS 12615. The power rating shall be at least 125% of maximum power requirement. The other features of motors shall be as follows :

- ✓ Type of duty : Continuous (Sl)
- ✓ Method of starting : Star-Delta
- ✓ Class of insulation : F (Temperature rise limited to class B)
- ✓ Type of enclosure : TEFC and Flame proof
- ✓ Degree of protection : IP 55

(3) Blade Replacement Programming

An external rapid measuring system permits an evaluation of the blades wear without opening the machines, so that the blade replacement (average life

about 12,000 hours) can be programmed in advance according to individual work needs.

The rotor is supported at both ends by roller bearings and is axially located by an angle ring which maintains the running clearances necessary for high volumetric efficiency.

The efficiency of these machines is high and does not alter in time because the blades' wear is compensated for automatically.

(4) Construction Features

Casing shall be robust and defect free casting, cleaned by sand blasting/shot blasting. Casing shall be steel castings are used, they shall conform to Cast Iron IS 210 Gr. FG260.

The rotor slots shall offer free sliding movement to vanes during operation. Rotor shall be Cast Steel ASTM A 216 WCB. Rotor shall have axial clearance and bottom clearance and mentioned by the supplier for the assembly of the rotor. Type of bearings, their lubrication and the type of fit on the rotor shall also be furnished by the manufacturer.

The motor shall have sufficient starting torque so as to be capable of starting the compressor from a no-load condition and running it up to full speed.

Coupling shall be friction disc coupling type, internal gear type may be used. The coupling shall be so designed that it can be dismantled without disturbing the internal components of the compressors and motor. Coupling shall be suitable for expansion and any other movement of the shaft.

Gears shall be of suitable design and made generally conforming to IS: 4702-Accuracy requirements for high precision gears.

In case of belt drives, the V-belts shall be according to IS: 2494-Specification for V-belts for industrial purposes. If more than one V-belt is required, a matched set shall be supplied.

Removable guards shall be provided on all movable parts which are likely to be hazardous to operating personnel.

If guards are not removable, for example, fly-wheel guards, access openings (if necessary with covers) shall be provided for access to any part requiring attention or for rotary parts manually.

Stainless Steel Filters shall be located such as to permit easy cleaning. Filter shall be placed as close to compressor as possible. The filtering particle size shall be microns and required efficiency

For non-lubricated compressors, dry filters shall be furnished.

The cooler shall be of water-cooled type and shall conform to the following requirements.

Inter coolers and after coolers shall be designed on the air side to the design pressure not less than the safety valve set pressure. The design pressure for the water side shall be 3.5 bar minimum. The fouling factor to be used on water side shall be the relevant standard. Shell and tube type of cooler is engaged, the design and construction shall be according to IS: 4503-Specification for shell and tube type heat exchangers.

Cyclonic Separator shall be provided to remove oil and condensate after each air cooler.

The air receiver shall be provided after the final discharge shall be manufactured according to IS : 7938-Specification for air receivers for compressed air installation, Where automatic drain traps are used, these shall be provided with isolating valves to allow trap maintenance with the compressor running.

The pipe work shall be of flange end connection confirming to BS EN 1092-1, required with the compressor consists of:

a) **Air piping -** Inlet and final discharge piping, and

b) **Auxiliary pipe work -** Lubricating oil, cooling water drain and vent, and instrument air piping.

Auxiliary pipe work, required for lubricating oil, cooling water drain and vent and instrument air shall be machine mounted in fully erected and fabricated condition by the manufacturer.

The water pipe work shall be fitted with high point vent and low pipe drain connection such that the entire system can be vented and drained.

Controls and Instrumentation

The following instruments shall be included in supply which is considered as minimum requirement. Extra instruments as specified by the purchaser shall also be included.
Pressure and temperature gauges, flow and level indications.

a) Air side -Outlet pressure gauge - each stage

- Outlet temperature gauge -final stage

b) Oil side - Oil level indicator - oil pressure gauge

c) Cooling water side - Cylinder jacket flow indicator for each parallel circuit.

-Temperature gauge at cooling water outlet
- Flowmeter for cooling water

Safety Devices -A suitable safety devices shall be provided to safeguard against high discharge air temperature.

Safety Valves- Final stage only shall be protected by a safety valve. The valve shall be sized for full capacity of the compressor with set pressure not more than 10 percent of the maximum operating pressure of the stage. The safety valve shall be mounted in such a manner that the setting is not disturbed by the vibration.

8.4 Rotary Air Blowers

(b) Compressor blowers shall be of the rotary tri lobe positive displacement type, each provided with inlet filter and silencer, pressure reducing valve, pressure gauges, pressure relief valve, drain, air flow indicator and acoustic bend or silencer in the delivery branch. Bearing housings and gear boxes shall be separated from the blower housings by air spaces. The units shall be complete with a self-contained oil cooling system for

the bearings. The blowers shall be housed inside acoustic enclosure. The noise level shall not exceed 85 dBA at 1 meter from the Blower.

(c) The bearings shall be generously designed to give long operational life. Bearings at the drive end may be oil or grease lubricated. The gears and bearings at the non-drive end shall be oil lubricated. Bearings shall be provided with oil throwers to prevent leakage of oil. The blower shall be arranged for horizontal inlet and vertical outlet, delivery velocity not exceeding 16 m/s and each blower shall be provided with following components but not limited to:

(1) Common base frame for Blower & Motor.
(2) Inlet silencer and filter, with inspect replant net to avoid insect entry.
(3) Discharge Silencer & non-return valve in delivery branch.
(4) Motorised Butterfly valves in both inlet and delivery branches with metal to metal sealing.
(5) Pressure relief valve or excess pressure safety device.
(6) Bellows SS 304 type couplings on inlet and delivery piping & on suction & delivery silencers.
(7) Acoustics Enclosure.
(8) V-Belt drive arrangement with Belt Guard.
(9) Isolating valves, Pressure reducing valves & Pressure gauges
(10) Air Flow meters, Temperature gauges.
(11) Water trap.
(12) Gravel filter.
(13) Blower piping individual delivery pipe shall be provided dummy flange extension with pipe spool on opposite side of common header to reduce the noise level.
(14) After cooler arrangement for each blower on outlet side.

(d) The interconnecting pipe work shall be flanged to BS EN 1092-1/BS: 4504. A drain cock shall be provided at the lowest point in each delivery pipe work along with reflux valve. Individual stop valves and safety valves shall be provided for each unit.

(e) Blowers shall be driven by squirrel cage motors through a matched V-belt drive. Motors shall be mounted on slide rails mounted on a common bed plate, to facilitate the tensioning of the belts. Blowers shall not run above 1000 rpm and prime movers also.

(f) Each delivery branch shall include a drain at the lowest part and a reflux valve.

Each blower shall contain one inlet air pressure, one discharge air pressure, and one discharge air temperature gauge. The pressure gauges shall be calibrated in kPa absolute and be of the compound type. The gauges shall have circular dials, minimum 100 mm diameter with black figures on white background. Pressure gauges shall be furnished with pulsation damper. Temperature gauges shall be manufactured with standard temperature bulb.

(g) Appropriate after cooling arrangement for each blower shall be provided at the blower discharge line so as to bring down the outlet air temperature within tolerable limits, so as to safeguard the life of fine bubble diffusers and satisfactory performance of the same. This cooling arrangement is mandatory with all types of Blowers after cooler shall be preferably shell and Tube type.

	Description	**Material of Construction**
a	Blower Housing	CI IS 210 Gr. FG 200 or 220
b	Lobes	CI IS 210 Gr. FG 200 or 220
c	Shaft	Carbon Steel (High Tensile) EN 19
d	Base plate	MS fabricated Epoxy painted
e	Inlet filter, silencer casing	Galvanised Steel
f	Acoustic enclosure	Al-Zn coated steel, insulated with glass wool
g	Blow-off silencer and motor cooling silencer	Galvanised Steel
i	All connecting accessories and anchor bolts	AISI 316

8.4.1 Acoustical Enclosure

(a) Provide a factory assembled acoustical enclosure around the entire blower. Disassemble the enclosure as necessary for shipment. Provide either removable or hinged doors for access to all blower parts and components for servicing and maintenance. Size access panels to allow easy access by a single operator. Hinges, fasteners, and appurtenances shall be stainless steel.

(b) Provide clear, transparent Lexan or plastic windows to visually observe gauges and lever arms.

(c) Mount an auxiliary exhaust fan and thermostat on the acoustical enclosure to provide air circulation after blower shutdown or when the temperature inside the enclosure exceeds 40°C.

(d) The free field A-weighted sound pressure level measured in four quadrants at 1 metre distance from the enclosure shall average 85 dBA, or less. Measure with a Type 1 instrument suited for checking compliance with Environmental and Occupational Noise Rating Recommendations.

8.5 Occupational Health and safety Management

In order to prevent the industrial accident, for example a fall accident, physical damage, drowning, toxic chemicals and Gas, dropping, flammable oil and Biogas, which may occur during O&M and Construction stage, the contractor shall provide safety measures that needs to be implemented.

The sludge digestive facilities need to be enhanced in the incidental facilities, and monitoring apparatus for stable generation of the digestive Bio-gas.

Since digestive gas is highly flammable, the constructor shall provide suitable safeguards and monitoring devices for preventing an outbreak of an explosion, accident, and a fire.

Moreover, preparation of early firefighting devices is required for emergency action.

In the sludge treatment machine building a ventilation system and a gas disclosure detector shall be provided in order to secure a worker's labor and safety.

The outside of the sludge digestive facilities shall be installed with a sign prohibiting smoking and fire, and safety education shall be provided to the personnel periodically.

8.6 Biogas Engine & Heat Recovery System

General

Cleaned Biogas shall be supplied to Biogas engine to produce electric power and take advantage of waste energy during running engine by heat recovery system so called “co-generation unit”.

The work shall include but not necessarily be limited to the following;

(1) Gas Engine and Generator with Electrical Panel.
(2) Gas supply line and valves.
(3) Pressure relief valves with flame arrestors.
(4) Flame arrester and trapping assembly.
(5) Gas filter.
(6) Water trap.
(7) Gas flow meter
(8) Gas line distributor valves.
(9) Pressure meter.
(10) Pressure switch for gas – low/high pressure indication
(11) Solenoid valve
(12) zero pressure regulator
(13) Drain.
(14) Other necessary items.

8.6.1 Biogas Engine

(a) Generated 100% of biogas shall be utilized to run Gas engine and produce electric power by generator. Electrical efficiency of power generation shall be minimum 40 % and at least 90% of utilization rate annually under continuously on duty for about 8,000 hr.

(b) Produced electric power shall be supplied to main power line to run the Plant.

(c) Assembled engine and generator shall be operated under the following condition;
(1) The system should be suitable for continuous/ base load operation.
(2) Momentary speed variation shall not exceed at 10 % in no time.
(3) Normal speed variation shall be not exceeded at 5 %.
(4) Recovery time shall be within eight seconds.
(5) Location to be operated shall be in Bangalore in India.
(6) The assembly shall be installed in the engine room with heat recovery equipment.

(d) The Assembled Engine shall be manufactured with necessary in-built safety features in comply with relevant applicable Indian/international standard.

(e) Each Engine shall be provided with following components but not limited to the following:

- Engine body with spark ignition system
- Starting system (Batteries)
- Fuel supply system
- Carburetor
- Distributor
- Speed adjusting device (electronic speed Governor), throttle valve
- Ignition system
- Silencer (pollution control device)
- Cooling system
- Lubricating oil system
- Pressure relief and safety valves.
- Pressure gauges, Level gauges
- Rotating meters, Thermometers and Flow meters.
- Air and oil filters and strainers
- Noise protection, and
- Expansion joints, valves. pipe line for gas and water.
- Tools (Special and maintenance with a tool box), firefighting equipment and safety gears(helmets, ear muffs, earplug, safety goggles etc)
- Portable rotating meter, Potable noise meter, Potable vibration gauge, Potable thermometer
- Integral robust fabricated steel base frame with anti-vibration mounting pads.
- Anchor bolts
- Back-up cooling system
  - Dry cooler – For emergency cooling
  - Three way valve – To control engine water temperature

(f) Engine Body

(1) Fine finished Liner of cylinders shall be manufactured with abrasion resistance made by special metal.

(2) Common bed shall provide with shock prevention device and its stoppers.

(3) Total vibration value at common base on duty shall not be exceeded at 0.3mm measured by axial and horizontal direction respectively.

(4) Crankshaft and propeller shaft shall be made by grade AA forged steel.

(5) Combustion system shall provide air filter, gas carburetor and spark plugs, air compressor.

(6) Speed adjusting device shall provide with perceptive action.

(g) Starting system

Engine shall be started by appropriate electrical system. Automatic start and stop program shall be in-built to the Genset.

(h) Method of Power transmission

Biogas engine shall be linked to power generator by flexible joint or hydraulic coupling.

(i) Cooling system

Jacket water system shall be applied and the heat energy will recovered by heat exchangers to heat sludge in the primary sludge digestion tank.

(j) Silencer

The silencer and its pollution control device on its exhaust pipe shall provide to meet according to the national standard.

(k) Noise level not to exceed 85 dBA measured at 1.86 meter from the Engine.

(l) Exhaust gas component from engine shall be in complying with the ambient air standard.

(m) Protection devices

Mechanical protection of overload and emergency stop shall provide. Safety covers shall be provided over rotating parts.

(n) Engine management system shall be provided so that if the actual methane number is lower than the specified the knock control shall responds and first the ignition timing shall changed at full rated power, secondly the rated power shall reduced.

(o) Spare parts shall be provided as per the quantities required for the period indicated below, but not limited to;

Item	Quantity

One year maintenance parts;	2 sets
Spark plugs;	7 years
All kind of filters;	7 years
All kind of Packing:	7 years
Standards spear parts	2 sets
Oil & Grease;	2 years
Tools with Box;	1 set / engine

8.6.2 Heat Recovery system

(a) Heat recovery system to utilize waste heat from running engine shall be provided to heat up 100% of inlet thickened sludge to primary sludge digestor from 35 to 43 degree Celsius. Generated gas shall also supply to heat exhaust exchange and gas boiler unit so called “waste heat recovery boiler” as backup system to keep sending hot water to sludge heat exchanger to warm up digestion tank as required in case engine is not service. Flue gas heat exchanger shall be SS 316 material of construction.

(b) Hot water control valves and water temperature meter shall be provided to control hot water flow in case of not to use heat exhaust/ heat exchange or heat from gas boiler is required.

(c) It is absolutely necessary to keep monitoring water flow through Digester heating circuit when Engine is in operation since there is danger of exhaust Heat Exchanger severe damage.

The work shall include but not necessarily be limited to the following;

(1) Jacket heat exchanger.
(2) Exhaust heat exchange and gas boiler unit.
(3) Cooling water pumps
(4) Cooling towers
(5) Heating water pumps
(6) Hot water control valves
(7) Hot/Low water tank
(8) Safety valve – heating water circuit
(9) Safety valve – cooling water circuit
(10) Jacket water supply unit
(11) First filling of Genset like lube oil, engine jacket water, anti-corrosive agent and Battery acid

8.6.3 Room for Engine/Generator

(a) Engine and generator shall be coupled and mounted on steel base frame with inserted anti-vibration elements. Transmission of the vibration shall be minimal. There shall not be any anti-vibration concrete blocks and foundation shall be sufficiently strong to take care of static load.

(b) Gas leakage detectors shall be provided in the Engine room along with alarm annunciation.

(c) Requirement for engine room floor: Dust free concrete or pavement

(d) Ventilation of engine room:
Engine room should be well ventilated by forced ventilators with minimum ten times per hour air change rate.

(e) Minimal air change quantity technically required corresponds to the heat lost from cogeneration unit and inlet air to be burned by engine.

(f) Other safety requirements for air change shall be solved according to locally valid safety rules and standards to the satisfaction of Engineer.

(g) Oil tank shall be located on the cantilever on the wall in the engine room.

(h) The electrical switchboard with base frame shall be located in individual room adjacent to Co Generation unit.

(i) Venting (degassing)

Piping above the roof with min. distance 3 m from possible source of the fire.

(j) Exhaust piping

(1) Independent exhaust piping of appropriate sizing leaded over engine room.

(2) Piping shall be made of stainless steel SS 304.

(3) Leaded into chimney – overpressure system required.

(k) Monorail with Manual Hoist of suitable capacity shall be provided in the Engine Room to facilitate Installation and maintenance of the Engine.

(l) Installation space

(1) Minimal free space from unit base frame on side of the unit 2000 mm (for both side).

(2) Minimal free space in front of electrical switchboard 1500 mm.

(3) Minimal free space from side where piping connection 1500 mm.

8.7 Valves

(a) Valves shall be as per internationally recognized standards. Flanges shall be machined on faces and edges. Flanges shall conform to ISO 7005, IS 6392, BS EN 1092-1/ BS 4504.

(b) Valves shall be double flanged type and the faces shall be parallel to each other. The flange face should be at right angles to the valve centre line. Back side of valve flanges shall be machined or spot faced for proper seating of the head and nut.

(c) Valves buried or installed in underground chamber, where access to a hand wheel would be impractical, shall be operated by means of extension spindle and/or keys. Wherever extension spindle is provided, the valve shall also be provided with suitable headstock.

(d) Valve of diameter 450 mm and above shall be provided with lifting eyes and shall have detachable bolted covers for inspection, cleaning and servicing.

(e) Valve shall be suitable for frequent operation as well as operation after long periods of idleness in either open or closed position.

(f) The valve stem, thrust washers, screws, nuts and all other components exposed to the water shall be of a corrosion resistant grade of stainless steel.

(g) Valves shall be free from sharp projections which are likely to catch and hold stringy material.

(h) All the valve shall be of 10 bar rating.

(i) All valves in the plant shall be provided with dismantling joint/Flexible joint/SS bellows for ease dismantling.

(j) For all gas service and process air application the valve shall be Butterfly valves in Resilient seated (Biogas/Gas service) and Metal-Metal Seated (for process Air service).

8.7.1 Electric Actuator

(a) All local controls shall be protected by a lockable cover.

(b) Each actuator shall be adequately sized to suit the application and be continuously rated to suit the modulating control required. The gearbox shall be oil or grease filled, and capable of installation in any position. All operating spindles, gears and headstocks shall be provided with adequate points for lubrication.

(c) The valve actuator shall be capable of producing not less than 1½ times the required valve torque and shall be suitable for at least 15 minutes continuous operation.

(d) The actuator starters shall be integrally housed with the actuator in robustly constructed and totally enclosed weatherproof housing. The motor starter shall be capable of starting the motor under the most severe conditions.

(e) The starter housing shall be fitted with contacts and terminals for power supply, remote control and remote positional indication.

(f) Each starter shall be equipped as follows :
   (1) 2 No. Three phase magnetically operated line contactors with no-volt release and electrical and mechanical interlock.
   (2) 1 No. Three phase thermal cut-out device.
   (3) 1 No. Control circuit transformer fully protected by fuses on primary and secondary circuits.
   (4) 1 No. Set of “Open”, “Close” and “Stop” buttons.
   (5) 1 No. Local- Off-Remote switches with padlocking facilities.
   (6) 1 No. Set of torque and limit switches for “Open” and “Close” positions.
   (7) 3 No. Sets of auxiliary limit switches in each direction.
   (8) Valve position Analog Transmitter (i.e. Actuator accept To Read Analog signal from Actuator to PLC and also To Write Analog Signal from PLC to Actuator) & mechanical indicator and hand wheel for manual operation.
   (9) Reduction gear unit
   (10) Trip signals of Thermo switch, Torque Switch and Thermal Overload Relay shall be provided for Indication and also integrated to PLC.

8.7.2 Butterfly Valve

Butterfly valves shall be of double eccentric and resilient seated type generally as per BS EN 593 and IS 13095.

Butterfly valves shall be suitable for bi-directional pressure testing. The valves shall be of double flanged long type.

The valves shall be electrically/pneumatically/manual operated to suit the process requirement mentioned elsewhere in this tender document. The valve shall be free from induced vibrations. Valve shall be suitable for mounting in any position.

The valve seat shall be of metal to metal seated design for Process Air and Backwash Air application. All fasteners shall be set flush so as to offer the least resistance possible to the flow through the valve.

The shaft shall be stainless steel with Bronze or equivalent seal with self-lubricating bearings. Disc pins shall be stainless steel. Rings shall be bi-directional self-adjusting suitable for pressure or vacuum service. Valve shafts shall be a one-piece unit extending completely through the valve disc, or of the "stub shaft" type, which comprises two separate shafts inserted into the valve disc hubs.

All valve spindles and hand wheels shall be positioned to give good access for operational personnel. Valve of diameter 450 mm and above shall be provided with enclosed gear arrangement for ease of operation. The gear box shall be of worm and worm wheel design type, totally enclosed, grease filled and weather proof. The operation gear shall be such that they can be opened and closed by one man against an unbalanced head of 1.15 times the specified rating. Valve and gearing shall be such as to permit manual operation in a reasonable time and not exceed a required rim pull of 200 N. All hand wheels shall be arranged to turn in a clockwise direction to close the valve, the direction of rotation for opening and closing being indicated on the hand wheels.

Material of construction of valves shall comply with following requirement:

Component	**Material**
Body	SG Iron IS 1865 Gr. 500/7/GGG50 or 400/15/GGG40

Component	**Material**
Disc	SG Iron IS 1865 Gr. 500/7/GGG50 or 400/15/GGG40
Shaft	Stainless Steel; ASTM A 276 Gr. 431/420
Body Seat	Stainless Steel ASTM A 276 Gr.316/ CF8M
Bearing	Stainless Steel/Bronze backed Teflon
Disc seat	Stainless Steel ASTM A 276 Gr. Gr.316/ CF8M
Body seat	Stainless Steel; ASTM A 743 CF8M
Internal Fasteners	SS 316
External Fasteners	SS316

The disc shall be designed to withstand the maximum pressure differential across the valve in either direction of flow. The disc shall be contoured to ensure the lowest possible resistance to flow and shall be suitable for throttling operation.

Valves shall be capable of closing against the maximum flow that can occur in system. The shaft shall be designed to withstand the maximum torque that will be imposed by the operator. It shall be secured to the discs by tapered stainless steel cotter pins.

Valves shall be provided with position indicator to show the position of the disc, mounted on the driven shaft end.

Rigid adjustable stop mechanism shall be provided within the gear box or elsewhere on the valve to prevent movement of the disc beyond the fully open or closed position (i.e. set points).

8.8 Propeller Exhaust Fan

(a) The fan should comply with IS 2312.

(b) The blades shall be of mild steel and properly balanced so as to avoid noise and vibration.

(c) The blade and blade carriers shall be securely fixed so that they do not loosen in operation. The means provided for securing the fan mounting or fan casing to the wall partition or window shall be such as to provide a secure fixing without damage to the fan or wall.

(d) Suitably designed guards shall be fitted to the inlet and the outlet side to prevent accidental contact. No flammable material shall be used in the construction of fan. Moulded parts, if used, shall be of such materials as to withstand the maximum temperature attained in the adjacent component parts.

(e) The fan shall have protective insulation or be capable of being earthed. A fan with protective insulation may be of all insulated construction or have either double insulation or reinforced insulation. Each fan should be provided with a 10 sq.mm mesh bird screen. The sheet used for the cowl should be 14 G.

8.9 Approved Vendor/Manufacturer/Make List-Mechanical Equipment

The naming of a manufacturer in this specification is not intended to eliminate competition or prohibit qualified manufacturers from offering equipment. Rather, the intent is to establish a standard of excellence for the material used, and to indicate a principle of operation desired.

	CONSOLIDATED Mechanical Equipment VENDOR LIST	
S.NO.	**ITEM DESCRIPTION**	**APPROVED VENDOR/ MANUFACTURER/ MAKE**
1	Biogas Scrubber System, Biogas Dryer, and Safety Equipments	M/s Green Power
		M/s CRA Energy
		M/s GGE Power
2	Biogas sliding Vane/Rotary Blower	M/s Swam
		M/s Usha Compressor
		M/s Everest
		M/s Mapro
		M/s Roflo Compressor
3	Biogas Engine and Accessories	M/s GE Jenbacher, Clarke Energy
		M/s Siemens, GGE Power

	CONSOLIDATED Mechanical Equipment VENDOR LIST	
S.NO.	**ITEM DESCRIPTION**	**APPROVED VENDOR/ MANUFACTURER/ MAKE**
		M/s MWM, Green Power
4	Stainless Steel Pipes	M/s Jindal
		M/s Prakash Steelage
		M/s. Remi Pipes
		M/s Roopam Steel
		M/s Ratnamani
5	Exhaust Fans	M/s Alstom
		M/s Howden
		M/s Bajaj
		M/s Marathon
		M/s Crompton
		M/s Almonard

All the equipment, to be supplied under this contract has to be from experienced manufacturer. The equipment of only those manufacturers, who have sufficient proven experience of manufacturing the respective equipment of similar capacity, shall be considered.

Note-1: In order to achieve standardization for appearance, operation, maintenance, spare parts and manufacturer's service, like items of equipment provided hereunder shall be the end products of one (1) manufacturer.

Note-2: In the event that the contractor wishes to propose alternate makes for the equipment mentioned above, he shall submit the following during detailed engineering:

1) Demonstrate that the proposed makes are “equivalent ” to the approved makes. The contractor shall ensure that alternate makes proposed, shall comply completely to the tender specifications, before the same is submitted for approval.

2) Submit ISO certificates for the OEM.
3) Submit quality certificates that the equipment adheres to, as required under this contract.
4) Submit product brochures for the proposed equipment, with information on spares availability and service setup in employer's country.
5) Manufacturer involved in manufacture of specified proposed equipment for at least 10 years before bid date
6) End user performance certificates for minimum 5 successful individual installations of similar size or capacity as per this contract with the proposed equipment and model no, commissioned and satisfactorily operating for at least five years before bid date.
7) Manufacturer to provide full contact information for each reference as part of submission.

And the above qualities and requirements shall be demonstrated and evidenced by inspection of manufacturing units and successfully installed plants (at the End users plant/premises) for the equipment's desired and successful operation and certification by the Employer/Engineer (BWSSB)/Representative.

The Employer shall reserve the right to accept or reject the Bidder proposed makes of Equipment.